

ORIGINAL

THESE RESULTS ARE IN ACCORDANCE WITH THE FINDINGS OF OTHER STUDIES THAT HAVE SHOWN THAT THE USE OF A SINGLE-STEP PROCESS CAN BE EFFECTIVE IN IMPROVING THE QUALITY OF THE PRODUCT.

SUMMARY

SEA congratulates the Commission for the issuance of a substantial and progressive set of proposed rules as presented in the Notice. In this proceeding the Commission is seeking to increase the capacity in the PLMRS bands below 512 MHz, to promote more efficient use of this spectrum, and to simplify and consolidate the rules governing these bands (collectively referred to as "refarming"). The Notice includes many innovative proposals which consider the necessary means to implement new technology into the mature and crowded bands below 512 MHz. SEA offers comments on how some of these proposals might be improved. SEA believes the basic framework of the proposed rules to be sound.

SEA recommends channel plans which divide the spectrum into the smallest practical single channel width. We submit that a 5 kHz channel plan will introduce significant new capacity potential to the mature bands below 512 MHz. With the flexibility to "stack" channels, licensees will be able to use a variety of technologies and develop a plethora of new applications and services. We encourage the Commission to be aggressive in forecasting what new technology will offer the PLMRS over the next 20 years. Furthermore, SEA proposes that the refarming transition plan forego the proposed intermediate step of converting present operations to reduced deviation analog FM operations. We believe a transition directly to 5 kHz channel spacings, along with the flexibility of channel stacking, offers many advantages over the two-stage approach.

SEA supports the spectrum efficiency standard as proposed in the Notice. We view this approach as one that can be easily confirmed in type acceptance filing and will yield the intended result: greater spectrum efficiency.

SEA supports the proposed mechanisms to achieve channel exclusivity. Service category eligibles should be given tools to convert designated portions of shared spectrum into exclusive use spectrum in and around urban areas. However, channel exclusivity should not be a goal unto itself.

SEA proposes a schedule of ERP/Antenna height limits which includes different requirements for urban and non-urban environments. We believe such an approach provides a compromise between needs of greater capacity in the large population centers and wide area coverage in lower population density areas.

SEA suggests that the Commission discard the innovative shared use concept as proposed in this docket. Innovative shared channels, if adopted as proposed, would hinder the introduction of stacked channels.

Finally, SEA proposes the FCC provide further direction to the frequency coordination committees in order that they may develop plans for channel pairings and the implementation of trunking technology into the bands below 512 MHz.

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Replacement of Part 90 by Part 88 to
Revise the Private Land Mobile Radio
Services and Modify the Policies
Governing Them

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PR Docket No. 92-235

COMMENTS OF SEA INC.

SEA Inc. ("SEA"), by its undersigned counsel, hereby files its comments in response to the FCC's Notice of Proposed Rule Making ("Notice") in the above captioned proceeding.¹

INTRODUCTION

SEA Inc., a wholly-owned subsidiary of Datamarine International, Inc., is a manufacturer of narrowband land mobile radio equipment. SEA has submitted comments in numerous rulemaking proceedings affecting mobile radio users. For over a decade, SEA has been involved in the development of narrowband technology at the technological and regulatory levels. SEA manufactures and markets amplitude compandored single sideband (ACSB) radio equipment used in voice and data operations in 5 kHz wide channels on 150 MHz and 220 MHz Private Land Mobile Radio (PLMRS) frequencies. SEA is now shipping type accepted narrowband products for the new 220-222 MHz frequency band.

¹ Notice of Proposed Rule Making, PR Docket No. 92-235, November 6, 1992.

SEA's experience in introducing systems and products into the 150 MHz band perhaps makes the company uniquely qualified to discuss the introduction of new technology into a mature and, in many areas, over-taxed frequency band. In 1985, the promise of new narrowband technology was to help alleviate the crowding of the radio spectrum in urban areas. Simple application of new rules² to permit the use of narrowband was the only mechanism provided to gain benefit from this new technology. However, a number of problems existed which, we believe, required further regulatory action to implement narrowband successfully.

Problem: Few multi-channel opportunities. Since there was no plan or incentive to actually replace existing FM systems with narrowband systems³, the first narrowband channels were placed exclusively between existing channels. This was difficult to implement since most of the existing channels were used by 15 kHz spaced, geographically separated systems. The exception was the Business Radio Service where, at that time, uncoordinated and shared 30 kHz spaced channels resided. The Commission made available three channels that could be used as mobile frequencies for repeater operation, when paired with narrowband Business channels. This proved to be an inadequate incentive to persuade a substantial number of users to migrate to narrowband 5 kHz operation.

² See PR Docket 84-279.

³ That is, divide up 30 kHz or 15 kHz channels into multiple 5 kHz channels.

Problem: Shared use band. With no channel exclusivity (and the presence of intramarket co-channel users), there is an operational requirement to utilize interoperable equipment so a clear channel can be monitored. Users of heavily shared channels are essentially unable to utilize any new technology.

Problem: New spectrum became available. The influence of market forces on a migration to new spectrum efficient technology was compromised by the opening up of additional spectrum⁴. The availability of new spectrum removed the sense of urgency from the need to implement narrowband technologies in the 150-174 MHz band.

The complex set of issues involved in this proceeding need to be dealt with in turn. SEA, in its analysis of this initiative, has made an attempt to consider the broad range of environments (from urban to rural) and the diverse sets of applications (from simple dispatch to Public Safety). To lump all applications and environments into a single model would not be constructive for this proceeding. In the same context, SEA believes a single technology cannot address all needs. Therefore SEA supports rules which permit the greatest degree of flexibility.

SEA believes that the refarming initiative will only be successful if innovation and efficiency are required, the means to

⁴ See 900 MHz Reserve Allocations, 2 FCC Rcd 1825 (1986); recon. denied, 2 FCC Rcd 6830 (1987).

move to new technology are in place, and the required incentives are provided.

DISCUSSION

Spectrum Efficiency Standards

SEA believes the intent of establishing a spectrum efficiency standard is to create an efficiency threshold which products/technologies must meet or surpass as a condition of application to the refarmed frequency bands. To this end, SEA supports the 4800 bps/5 kHz efficiency standards proposed in the Notice⁵, for the following reasons: 1) it will help accomplish the intended goal of greater spectrum efficiencies; 2) it is reasonable and achievable even with today's technology; 3) it will compel manufacturers to develop technologies and products which provide better spectrum utilization; and 4), it is simple and easy for manufacturers and users alike to understand.

SEA suggests that conformance to the spectrum efficiency standard be a condition of type acceptance. Manufacturers could prove conformance by submitting occupied bandwidth data under the minimum (or greater) communications link modulation conditions. For data transmission this would be a minimum of 4800 bits per second⁶ per 5 kHz of channel space. We see no reason to change the

⁵ Notice, Appendix A, page 118 (proposed ¶88.433).

⁶ The Notice uses the data signaling rate unit of baud in the drafted proposal. SEA assumes this was an oversight and suggests the term baud be replaced with the data bit rate unit of bits-per-second (bps).

procedures for voice modulation transmitters⁷. Making this standard a condition of type acceptance would not, in our view, be a significant burden to the Commission or to manufacturers. Further, it would avoid marketplace confusion over conformance responsibility; the onus would clearly be on the manufacturers to conform.

SEA believes the expression "spectrum efficiency standard" is perhaps misleading. It is tempting to try to quantify spectrum efficiency using formulas which are functions of every possible land mobile variable parameter. We anticipate some commenters will suggest codification of such a formula. In our view, this overlooks the intent of the rule and masks the issue. We agree with the intent of the rule, and we think the adoption of the rule is essential to the success of the refarming effort. However, we believe that no single rule can be completely effective as a means to realize the absolute maximum capacity of the bands in question. There are other factors in the analysis of proper spectrum utilization, such as the necessity of certain applications (e.g.,

Exclusivity

Channel or spectrum exclusivity is effective as a means to accomplish spectrum efficiency. The granting of exclusivity (meaning a guaranteed co-channel/co-spectrum protected environment) can be applied as an incentive to use new technology and to create a better frequency re-use environment. The use of new technology and the application of frequency re-use is most important in the crowded urban markets. SEA believes a goal of this proceeding should be to convert, to the greatest extent possible, the urban markets' re-farmed spectrum to exclusive use. Therefore, SEA supports the adoption of the Commissions exclusive use overlay (EUO) plan.

Since rural/suburban or non-urban environments do not require intense frequency reuse and can, in general, benefit from lowest-cost wide area coverage systems, we do not believe channel exclusivity should be required in these areas.

As important as the goal of exclusive use is the means to accomplish it, since as the non-urban markets evolve into urban markets, conversion of shared spectrum to exclusive use spectrum will be a continuous process. Our comments on how this could be accomplished are presented in the later section titled "**ERP and HAAT Limits**".

Radio Services

SEA feels it is not a manufacturer's place to interject specific recommendations regarding the consolidation of the PLMRS

categories, since this is mainly the interest of the user groups.

We do believe, however, that there is merit to the concept of

consolidation of the different ~~various~~ spectrum into contiguous

introduction of the new SMR category into the 150-162 MHz band which is definitely a reallocation issue. In spite of the meritorious intent, the introduction of this new classification appears to cause several problems (see "Innovative Shared Use Channels" below).

SEA recommends the Commission avoid making significant changes to the present allotment of spectrum or to the current eligibility requirements. By largely retaining the current scheme, spectrum speculation should not be a concern.

Technical and Operational Issues

Channel Plan

SEA supports the Commission's proposed channel spacing of 5 kHz⁹ for the 150-174 MHz band. We prefer this channel spacing over the 6.25 kHz spacing proposed by the Commission for the 421-512 MHz band. The 5 kHz plan will enable a simpler transition, since the existing channel spacings at 150-174 MHz are integer multiples of five, i.e., 15 and 30 kHz. In contrast, 15 and 30 are not integer multiples of 6.25, so a transition plan to 6.25 kHz would be awkward and would certainly require several phases.

SEA proposes that the Commission adopt a 5 kHz channel plan for the 421-512 MHz band, as well as for the 150-174 MHz band. We do not believe there are any significant technological barriers to the application of 5 kHz narrowband technology to the UHF bands. We think it is appropriate to select the lowest practical channel

⁹ With "technical flexibility." See Notice at 15.

width for the rudimentary channel spacing. A 5 kHz plan is superior because it offers 25% more channels than a 6.25 kHz plan, and these additional channels create greater flexibility as a basis for more efficiency. We believe, as do others, that linear modulation technologies should continue to advance through the next decade¹⁰. Because of this we believe that 5 kHz channels will be able to support a wide variety of applications including digital voice, intelligent vehicle highway systems, and facsimile.

Manufacturers will benefit from having the same channel width parameters applied to both bands. This should result in a cost savings for the communications buyer.

Since the both the benefit (more channels) and the capability (rapidly advancing technology) exist, we recommend that the Commission adopt a 5 kHz channel plan for all of the refarmed bands.

¹⁰ See A. Davidson, L. Marturano, Impact of digital techniques on future LM (Land Mobile) spectrum requirements, IEEE Vehicular Technology Society News, May 1993, page 17. The authors "...project that in the late 1990's, the (spectrum) efficiency (of new technology schemes) will exceed 3.5 b/Hz". Linear modulation techniques make possible this level of information density. The authors also state, "(c)learly, spectrum efficiency is improved if more communications channels can be placed within a given band of spectrum. In the past, the ability to decrease the channel size has been limited by both the transmission bandwidth and frequency stability concerns. As described previously, we expect the application of advanced semiconductor technology to reduce the transmission bandwidth." On page 25, the authors state, "(t)here is very little doubt that modulation technology will begin the evolution from analog constant envelope to linear digital techniques in the 1992 to 1994 timeframe."

ERP and HAAT Limits

In general, SEA agrees that antenna heights and power limits are required to control spectrum pollution and to permit simple coordination of co-channel stations. Power and antenna height limits are required elements for an exclusive use environment. Maximum ERP is not currently specified for the bands below 512 MHz¹¹. Transmitters in the 150-174 MHz band and 450-470 MHz band presently are limited to a 350 watt maximum power output¹².

Spectrum pollution is a major spectrum management problem in U.S. cities. In many cases the output powers used by base station transmitters are set high for the sole purpose of penetrating the overwhelming noise and intermodulation distortion that exists in the urban environment. This practice, of course, just leads to further problems for other users. Adoption of power/height limits will help regain control of the situation, particularly as it exists in the 150-162 MHz band.

SEA recognizes that channels in the 150-174 MHz and 450-470 MHz bands are coveted by users for their excellent propagation characteristics. Inexpensive wide area coverage is afforded today in these bands and we believe it should be afforded in the future. SEA does not support the ERP/Antenna height schedule as proposed in the Notice because it would not permit reliable communications over the extended areas that some users presently require.

As stated above, SEA supports the conversion of the maximum

¹¹ Except for the 220-222 MHz band.

¹² See 47 CFR 90.205(b).

possible number of channels to exclusive use status in the urban markets. We do not think channel exclusivity is entirely necessary for non-urban areas.

Accordingly, SEA believes that the proper compromise approach should be to employ separate co-channel geographic separation schedules for urban and non-urban environments, with companion ERP/Antenna height limits. The difference between our two proposed schedules is predicated on the urban case being a 50 mile reuse environment and the non-urban being (predominantly) a 75 mile reuse environment.

Considerable comment was generated in the 220-222 MHz Service Rules proceeding¹³ regarding ERP/Antenna height limits. The limits adopted for the 220 MHz band are designed to provide a 38 dBu contour at about 45 km (22 miles)¹⁴. SEA believes the ERP/Antenna height limits for the 220-222 MHz band are valid for the 150-174 MHz and 421-470 MHz bands. We propose applying these same limits to non-urban systems in these two bands.

For urban systems, the Commission proposes a 50-mile re-use environment, which entails a 38 dBu contour at about 17.6 km (11 miles). This service area requires about 12.5 dB less base station ERP than a 22 mile 38 dBu service area. Table 1 expresses SEA's proposed schedules compared with the Commission's proposal.

¹³ See Report and Order, PR Docket No. 89-552, April 17, 1991, ¶ 110-116.

¹⁴ Id., ¶115.

Table 1: 150-216 MHz & 450-470 MHz ERP/Antenna Height Limits				
Antenna height above average terrain (HAAT)		Effective radiated power (ERP) (watts peak envelope power)		
meters	feet	Urban	Non-Urban	FCC Proposal
Up to 60	Up to 197	300	500	300
60-75	197-246	190	500	190
75-90	246-295	120	500	120
90-120	295-394	75	500	75
120-150	394-492	30	500	30*
150-225	492-738	15	250	5**
225-300	738-984	7	125	5
300-450	984-1476	3.5	60	5
450-600	1476-1968	1.5	30	5
600-750	1968-2460	1	20	5
750-900	2460-2952	1	15	5
900-1050	2952-3444	1	10	5
Above 1050	Above 3444	1	5	5

* To 180 meters

** Above 180 meters

SEA defines "urban" as that described in 47 CFR 90.635. SEA uses the term "non-urban" in place of "suburban". For the purpose of continuously increasing the area of frequency re-use, the definition of the areas that encompass urban systems¹⁵ should be updated periodically.

The above ERP/Antenna height schedules may be found to be appropriate for paired channel repeater station coordination. However, many channels in the 150-174 MHz band are used in single-channel simplex applications. Other limits, more restrictive than those proposed above, would be required to deal with potential base

¹⁵ Presently, systems located within 24 km (15 miles) of the geographic centers of the fifty designated urbanized areas (See 47 CFR §90.635, Table 1) are considered "urban" systems.

station-to-base station interference. It is difficult to assess whether frequency re-use and exclusive use are worthwhile goals for simplex channels. SEA urges the Commission adopt a different set of incentives for these channels to make use of new technologies.

SEA suggests the Commission make provision for the ability to "engineer-in" systems with regard to co-channel use. This is not only desirable in order to deal with the logistics of the adopted transition plan, but also for those cases that justify wider area coverage than permitted by the above limits. Furthermore, there will be considerable coordination of co-channel use in the frontiers between urban and non-urban areas for an indefinite period of time. For such conditions, the Commission should consider employing the above limits as guidelines as opposed to strict rules.

Emission Mask

The development of a suitable emission mask should consider

3) Optimization of the authorized bandwidth for the purpose of permitting the widest variety of modulation types, including digital modulation schemes with reasonable pulse shaping and filtering. This is a detail to be considered in devising the band edge.

4) Frequency stability of the transmitters to be used in the band.

SEA supports the emission mask proposed by the FCC in this proceeding for use in the 150-174 MHz band. This emission mask was developed for the 220-222 MHz band with the input of a large number of manufacturers, including SEA. A significant body of discussion was presented in the 220-222 MHz service rules proceeding regarding the critical elements of a suitable mask¹⁶. We feel this mask should be applied in all bands below 512 MHz.

This mask provides a reasonable amount of inherent real-world protection to adjacent channels. If adopted, no geographic restrictions would be required between adjacent channels, regardless of technology or bandwidth. This is because of the attenuation provided at the band edge (see Figure A-1 in Appendix A). An emission mask that offered less consideration of the edge of the channel would compromise flexibility. Without such band edge attenuation, a channel cannot be converted to (or from) multiple narrowband channels without serious concern regarding

¹⁶ See, e.g., Reply Comments of Advanced Mobilecomm, Inc., Reply Comments of Motorola, Inc., Reply Comments of SEA, Inc., Reply Comments of United Parcel Service, Inc., PR Docket 89-552, all filed April 26, 1990.

interference from (or to) an adjacent channel.

The emission mask is a key element of the concept of channel stacking. Indeed, SEA feels the emission mask is the foundation upon which the remainder of the refarming elements must rest.

Additionally, SEA supports the frequency tolerance schedule proposed in the Notice¹⁷.

Discussion of the transition plan, bandwidth reductions and reducing the deviation of existing FM systems

SEA has considered the Notice's approach of using a two-stage transition to more spectrum efficient technologies. The attractions to this strategy include: 1) the first stage of reducing the deviation of existing transmitters would theoretically cause a minimum of disruption to existing systems, and 2) doing so provides an avenue to phase out the geographic restrictions at 150-174 MHz and the low power restriction at 450-470 MHz on the respective offset channels. SEA's discussion of this concept specifically addresses the case of the 150-174 MHz band, but the same principles can be applied to 450-470 MHz. Appendix B is a

stability of old FM transmitters would likely reduce their performance when operating with new FM receivers¹⁸ (See Figure B-2 in Appendix B). Also, the existence of reduced-deviation transmitters (old or new) would limit the ability to integrate new technology licensees on adjacent channels (See Figure B-3), as it appears that the nearest adjacent narrowband channel would need to be spaced at least 15 kHz away. Were this the case, only one narrowband channel could be placed between two reduced deviation FM stations, old or new. Also the frequency stability of old transmitters would likely worsen the expected nominal adjacent channel interference to new narrowband (or equivalent) technology stations.

SEA believes that a transition plan which involves dependence on new products to operate on 15 or 12.5 kHz channels for an interim period would be considerably more disruptive than a direct transition to narrowband channel plan. Furthermore, it is apparent that the bandwidth reduction scheme would not permit elimination of the geographic restrictions that presently exist between adjacent 15 kHz-spaced channels. This means that this step, as a means to develop an environment conducive to conversion to exclusive use channels, would be fruitless. Finally, the reduced deviation

¹⁸ New FM transmitters are those that presumably would be sold during the interim period before the ultimate "narrowband or equivalent" technology introduction. These radios are depicted as being based on 12.5 kHz analog FM technology, with improved frequency stability, reduced deviation and greater receiver adjacent channel selectivity. It is not apparent how interim products could be dual mode (wide/narrow modulation acceptance) to deal with the old transmitters loose frequency stability.

environment would create a difficult if not impossible environment for the ultimate integration of narrowband or stacked channels.

A requirement to operate using narrowband or equivalent spectrum efficient technology within ten years of the release of the Report and Order of this proceeding is, in our view, a reasonable and appropriate goal. Our reasons are as follows:

a. There would be no marketplace ambiguity. The users, coordinators and manufacturers alike will have a clear direction to follow.

b. There would be no "new" interim analog FM equipment to budget and dispose of before true spectrum efficient technology is required.

c. There would be near term efficiency gains. An interim transition plan would not provide additional efficiency gains for many years.

For these reasons SEA believes a transition plan directly to a 5 kHz channel plan, along with the adoption of a suitable emission mask and "narrowband equivalency" efficiency standard should be pursued. We propose the following time table and incentives:

1. 1/1/94: Report and Order published in the Federal Register. New rules would permit the introduction of narrowband or equivalent technology immediately into the refarmed bands on a voluntary basis.

2. Prior to 1/1/99, preferred¹⁹ licensees that make exclusive use agreements with other co-channel licensees and construct one (1) narrowband station are eligible to retain two (2) adjacent narrowband channels. The licenses for the two adjacent channels will be issued by the FCC to the preferred licensee and may be transferred (to another service eligible) before construction. These channels would need to be constructed within two years of original issue. Alternately, the EUO licensee could construct all three channels as narrowband or as a three-channel "stacked" equivalent efficiency technology.

3. After 1/1/99 and before 1/1/2004, preferred licensees that make exclusive use agreements with other co-channel licensees and construct one narrowband station are eligible to retain one of the two adjacent narrowband channels. The license for the adjacent channel will be issued by the FCC to the preferred licensee and may be transferred (to another service eligible) before construction. This channel would need to be constructed within two years of original issue. Alternately, the EUO licensee could construct the two channels as narrowband or as a two-channel "stacked" equivalent efficiency technology.

4. After 1/1/2004, all licensees must operate as narrowband

¹⁹ Notice (proposed §88.187), page 75.

or equivalent. All products type accepted after this date must meet the efficiency standard²⁰.

SEA believes that, even with the extended construction schedules proposed above, greater efficiency gains can be made in the next ten years using the above (or similar) plan than by using a transition plan involving reduced deviation analog FM. We also believe the incentives to retain spectrum will compel licensees and user groups to give serious consideration to the use of new spectrum efficient technologies and that manufacturers will respond

has two major objections to the Commission's ISU proposal.

First, the proposed 15 kHz-spacing placement of ISU channels across the 150-162 MHz band would fragment the band such that the concept of channel "stacking" would be impaired. The capability to stack channels is important. Without it, many worthy spectrum efficient technologies would be precluded from contributing to the overall higher efficiencies required in the future. We believe it is the intent of the Commission in this proceeding to permit such technologies.

SEA's second major objection is that the ISU spectrum/channels would be made available to private carriers at the expense of other services and existing licensees. This is a reallocation of spectrum which we believe would be deleterious to existing users and future radio service eligibles for the bands in question. Private carriers might be inclined to use new spectrum efficient technologies and could probably contribute to the achievement of higher capacities in the refarmed bands. However, SEA feels that existing eligibles can be given adequate incentive to develop greater efficiencies.

For the above reasons SEA suggests the FCC forego the innovative use concept as defined in this proceeding.

Trunked Operation and Channel Pairings

SEA supports the Commission's proposal to permit centralized trunking of exclusive use channels below 512 MHz. Since the success of trunked system implementation in the refarmed bands

depends on the frequency coordinators, the FCC should direct the authorized coordination groups to:

- 1) develop suitable regional or nationwide channel pairings for the 150 MHz band, and
- 2) develop plans for the respective services implementation of trunking in all bands below 512 MHz.

Simplification of the Rules

In general, the proposed Part 88 greatly simplifies and consolidates rules which require such reorganization. SEA supports this endeavor.

SEA notes the following omissions and recommendations.

In proposed rule Section 88.429 (Power and Antenna Height Limits), we recommend a general note: "ERP calculated using transmitter peak envelope power output".

In proposed rule Section 88.801 (U.S./Mexican border area), we note the apparent omission of provisions for the 896-901/935-940 MHz and 220-222 MHz bands as set forth in Order DA 92-1491 (November 4, 1992).

CONCLUSION

For the foregoing reasons, SEA urges the Commission to adopt replacement rules for the Private Land Mobile Radio Services below 512 MHz that will best serve the public interest. SEA's proposals and comments contained herein reflect our views on what constitutes a reasonable and realizable plan. When coupled with the technical parameters we propose, the Commission's plan will achieve much higher spectrum efficiencies and the impetus for further technological growth in the Land Mobile services.

Respectfully submitted,

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